PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2000-019145
(43)Date of publication of application : 21.01.2000

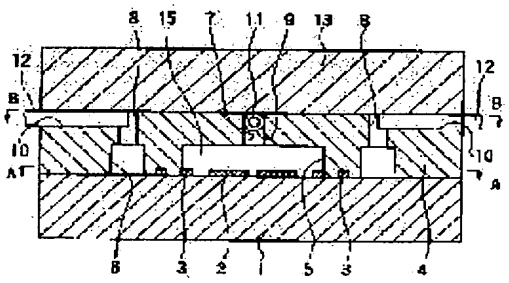
(51)Int.Cl. G01N 27/28
G01N 27/416
G01N 30/64
G01N 35/08

(21)Application number : 10-190459
(22)Date of filing : 06.07.1998

(71)Applicant : NIPPON TELEGR & TELEPH CORP <NTT>
(72)Inventor : MORITA MASAO
MORIMOTO TAKASHI
NIWA OSAMU
HORIUCHI TSUTOMU

(54) ELECTROCHEMICAL DETECTOR AND ITS MANUFACTURE

(57)Abstract:
PROBLEM TO BE SOLVED: To execute analysis of sample solution accurately.
SOLUTION: Working electrodes 2 and draw-out wires 3 are formed on a first layer board 1, and a circular groove 5, a ring-shaped groove 6 formed outside the circular groove 5, and a link groove for linking the circular groove 5 to the ring-shaped groove 6 are formed on a second layer board 4, and a sample solution introduction hole 7 linked to the circular groove 5 is formed on the second layer board 4, and a sample solution discharge hole 8 linked to the ring-shaped groove 6 is formed on the second layer board 4, and a radial flow cell is formed by jointing the first layer board 1 to the second layer board 4, and pipe storing grooves 9, 10 linked to the sample solution introduction hole 7 and the sample solution discharge hole 8 are formed on the second layer board 4, and a sample solution introduction pipe 11 and a sample solution discharge pipe 12 are fitted in the pipe storing grooves 9, 10, and a third layer board 13 is jointed to the second layer board 4.



3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]

[Claim 1]Laminate the 1st layer board, the 2nd layer board, and the 3rd layer board, and a pipe for sample-solution introduction and a pipe for sample-solution discharge are formed, An electrochemical detector having provided a liquid passage which connects the above-mentioned pipe for sample-solution introduction, and the above-mentioned pipe for sample-solution discharge, having formed a radial flow cell in the above-mentioned liquid passage, and forming a work electrode in the above-mentioned radial flow cell.

[Claim 2]Form the above-mentioned work electrode on the 1st layer board of the above, and the above-mentioned radial flow cell is formed between the 1st layer board of the above, and the 2nd layer board of the above, Laminate the 3rd layer board of the above on the 2nd layer board of the above, and the above-mentioned radial flow cell, a sample-solution introducing hole which was open for free passage, and a sample-solution discharge hole are formed in the 2nd layer board of the above, It is open for free passage with the above-mentioned sample-solution introducing hole between the 2nd layer board of the above, and the 3rd layer board of the above, and And the 2nd layer board of the above, The above-mentioned pipe for sample-solution introduction extended to the exterior of the 3rd layer board of the above is attached, The electrochemical detector according to claim 1 attaching the above-mentioned pipe for sample-solution discharge which was opened for free passage with the above-mentioned sample-solution discharge hole between the 2nd layer board of the above, and the 3rd layer board of the above, and was extended to the exterior of the 2nd layer board of the above, and the 3rd layer board of the above.

[Claim 3]It forms by a communicating groove which connects a round groove in which the above-mentioned radial flow cell was provided by the 2nd layer board of the above, a ring shaped groove established in the outside of the above-mentioned round groove and the above-mentioned round groove, and the above-mentioned ring shaped groove, The electrochemical detector according to claim 2 establishing the above-mentioned sample-solution introducing hole in the center of the above-mentioned round groove.

[Claim 4]A process of forming a slot for radial flow cell formation on a field of a side used as a plane of composition of a process of forming a work electrode on the 1st layer board, and the 1st layer board of the above of the 2nd layer board, A process of forming the above-mentioned slot for radial flow cell formation, a sample-solution introducing hole open for free passage, and a sample-solution discharge hole in the 2nd above-mentioned layer board of the above, A process of forming the above-mentioned sample-solution introducing hole, the above-mentioned sample-solution discharge hole, and a pipe storage slot that was open for free passage on a field of a side used as a plane of composition with the 3rd layer board of the above of the 2nd layer board of the above, A process of joining a side which has the above-mentioned slot for radial flow cell formation of a side which coincides the center of the above-mentioned work electrode, and the center of the above-mentioned sample-solution introducing hole, and has the above-mentioned work electrode of the 1st layer board of the above, and the 2nd layer board of the above, A manufacturing method of an electrochemical detector including a process of joining the 3rd layer board a process of attaching a pipe for sample-solution introduction, and a pipe for sample-solution discharge to above-mentioned pipe storage Mizouchi, and a side which has the above-mentioned pipe storage slot of the 2nd layer board of the above.

[Claim 5]A process of providing an insulator layer which has an opening after forming a work electrode on the 1st layer board, A process of forming a pipe storage slot which was open for free passage to the above-mentioned sample-solution introducing hole and the above-mentioned

sample-solution discharge hole on a field of a side used as a plane of composition of a process of forming a sample-solution introducing hole and a sample-solution discharge hole in the 2nd layer board, and the 3rd layer board of the above of the 2nd layer board of the above, A process to which a field in which the above-mentioned pipe storage slot of a side which coincides the center of the above-mentioned work electrode and the center of the above-mentioned sample-solution introducing hole, and has the above-mentioned work electrode of the 1st layer board of the above, and the 2nd layer board of the above was formed joins a field of an opposite hand, A manufacturing method of an electrochemical detector including a process of joining the 3rd layer board a process of attaching a pipe for sample-solution introduction, and a pipe for sample-solution discharge to above-mentioned pipe storage Mizouchi, and a side which has the above-mentioned pipe storage slot of the 2nd layer board of the above.

[Translation done.]

* NOTICES *

JPO and INPIT are not responsible for any
damages caused by the use of this translation.

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention relates to electrochemical detectors the object for flow injection analysis, for liquid chromatography, etc., and a manufacturing method for the same.
[0002]
[Description of the Prior Art]In flow injection analysis, liquid chromatography, etc., the electrochemical detection method is widely used as a method that it is simple and sensitivity is high. In this electrochemical detection method, the counterelectrode for sending current through the work electrode which causes the sample solution and electrochemical reaction, the reference electrode which makes potential of a work electrode regularity, and a work electrode is immersed in the sample solution, and is performed. And in flow injection analysis and liquid chromatography, The reservoir of carrier liquid or an eluate, a liquid-sending pump, and the injector of the sample solution are connected with a small tube, In the case of liquid chromatography, the isolation column for separation is further connected with a small tube, Arrange an electrochemical detector to the exit of an injector or an isolation column, and the sample solution is poured into an electrochemical detector from an injector or an isolation column, When the sample solution which rides and flows into carrier liquid or an eluate reaches an electrochemical detector, it is analyzing by monitoring the current produced according to the electrochemical reaction which occurs between a work electrode and the sample solution.
[0003]Such an electrochemical detector can be classified into cylindrical, a thin layer type, a wall jet type, etc. according to the shape of the work electrode to be used. It can classify into the cross-flow type which crosses and flows on a work electrode depending on how to flow through the sample solution, and the radial flow type which flows into a periphery from the center of a work

electrode. The type classified into a radial flow type according to a thin layer type in such structures, Namely, a radial flow cell is provided between two plates which separate minute clearance and are parallel, A work electrode is formed in one side of the two above-mentioned plates, and a sample-solution introducing hole (breakthrough for inlets) is established in another plate, The sample solution is introduced on the center of a work electrode from a sample-solution introducing hole, and the electrochemical detector of structure which flows into the periphery along with the work electrode in the radial flow cell between monotonous is most excellent in detection sensitivity.

[0004]In order to impress and measure fixed potential to a reference electrode in an electrochemical detection method to a work electrode, Only the sample of the oxidant which has reduction potential lower than the sample of the reduced form which has oxidation potential higher than the potential, or its potential will cause electrochemical reaction, and will be detected as a result. Therefore, in order to detect simultaneously the substance in which oxidation-reduction potentials differ, two or more work electrodes are prepared and it is necessary to impress and detect potential which is different in each work electrode. In a thin layer type radial flow type electrochemical detector for this purpose, A circular work electrode is divided into a sector and potential which is different in each work electrode is impressed (Iwasaki et al., Analytical Chemistry, 68 volumes, 3797 pages, 1996).

[0005]In such [conventionally] an electrochemical detector, The sample-solution introducing hole from which it escapes from the joint for connecting small tubes, such as an isolation column, and joint to a radial flow cell, The 1st block with which the sample-solution discharge hole (breakthrough for outlets) for discharging the solution which passed through the work electrode top, etc. were provided, and the 2nd block with which the work electrode was embedded are repeated on both sides of the separator of the thin film which pierced the center.

[0006]

[Problem(s) to be Solved by the Invention]However, in such an electrochemical detector, Since joint, a sample-solution introducing hole, a sample-solution discharge hole, etc. which were provided in the 1st block serve as dead volume, Below 1microl (microliter) extremely in the case of slight quantity, [the quantity of the sample solution] Since stagnation and dilution of the sample solution take place in a dead volume portion, and analysis becomes difficult and the block and the separator have not carried out adhesion etc., if power is not uniformly applied to the block, a crevice tends to be made and a solution may begin to leak. Therefore, the sample solution cannot be analyzed correctly. The characteristic which was excellent only after whose central point where the center and the sample solution of a work electrode are introduced in an electrochemical detector corresponded is shown. Since the quantity of the sample solution which flows on each work electrode becomes unequal and responses differ if the sector center and sample-solution introducing hole of the work electrode have shifted in having two or more work electrodes especially, the sample solution cannot be analyzed correctly. For this reason, although a guide pin is built to one of blocks and the work that the center and sample-solution introducing hole of a work electrode align is carried out, it is hard to suppress the gap of some by a backlash etc., and it needs delicate adjustment for whenever [frog] for a work electrode.

[0007]It was made in order that this invention might solve an above-mentioned technical problem, and it aims at providing the electrochemical detector which can analyze the sample solution correctly, and its manufacturing method.

[0008]

[Means for Solving the Problem]In [in order to attain this purpose] this invention, In an electrochemical detector, the 1st layer board, the 2nd layer board, and the 3rd layer board are laminated, A pipe for sample-solution introduction and a pipe for sample-solution discharge are formed, a liquid passage which connects the above-mentioned pipe for sample-solution introduction and the above-mentioned pipe for sample-solution discharge is provided, a radial flow cell is formed

in the above-mentioned liquid passage, and a work electrode is formed in the above-mentioned radial flow cell.

[0009]In this case, form the above-mentioned work electrode on the 1st layer board of the above, and the above-mentioned radial flow cell is formed between the 1st layer board of the above, and the 2nd layer board of the above, Laminate the 3rd layer board of the above on the 2nd layer board of the above, and the above-mentioned radial flow cell, a sample-solution introducing hole which was open for free passage, and a sample-solution discharge hole are formed in the 2nd layer board of the above, It is open for free passage with the above-mentioned sample-solution introducing hole between the 2nd layer board of the above, and the 3rd layer board of the above, and And the 2nd layer board of the above, The above-mentioned pipe for sample-solution discharge which attached the above-mentioned pipe for sample-solution introduction extended to the exterior of the 3rd layer board of the above, and was opened for free passage with the above-mentioned sample-solution discharge hole between the 2nd layer board of the above and the 3rd layer board of the above, and was extended to the exterior of the 2nd layer board of the above and the 3rd layer board of the above is attached.

[0010]In this case, it forms by a communicating groove which connects a round groove in which the above-mentioned radial flow cell was provided by the 2nd layer board of the above, a ring shaped groove established in the outside of the above-mentioned round groove and the above-mentioned round groove, and the above-mentioned ring shaped groove, and the above-mentioned sample-solution introducing hole is established in the center of the above-mentioned round groove.

[0011]A process of forming a work electrode on the 1st layer board in a manufacturing method of an electrochemical detector, A process of forming a slot for radial flow cell formation on a field of a side used as a plane of composition with the 1st layer board of the above of the 2nd layer board, A process of forming the above-mentioned slot for radial flow cell formation, a sample-solution introducing hole open for free passage, and a sample-solution discharge hole in the 2nd above-mentioned layer board of the above, A process of forming the above-mentioned sample-solution introducing hole, the above-mentioned sample-solution discharge hole, and a pipe storage slot that was open for free passage on a field of a side used as a plane of composition with the 3rd layer board of the above of the 2nd layer board of the above, A process of joining a side which has the above-mentioned slot for radial flow cell formation of a side which coincides the center of the above-mentioned work electrode, and the center of the above-mentioned sample-solution introducing hole, and has the above-mentioned work electrode of the 1st layer board of the above, and the 2nd layer board of the above, A process of joining the 3rd layer board a process of attaching a pipe for sample-solution introduction and a pipe for sample-solution discharge to above-mentioned pipe storage Mizouchi, and a side which has the above-mentioned pipe storage slot of the 2nd layer board of the above is performed.

[0012]A process of providing an insulator layer which has an opening in a manufacturing method of an electrochemical detector after forming a work electrode on the 1st layer board, A process of forming a pipe storage slot which was open for free passage to the above-mentioned sample-solution introducing hole and the above-mentioned sample-solution discharge hole on a field of a side used as a plane of composition of a process of forming a sample-solution introducing hole and a sample-solution discharge hole in the 2nd layer board, and the 3rd layer board of the above of the 2nd layer board of the above, A process to which a field in which the above-mentioned pipe storage slot of a side which coincides the center of the above-mentioned work electrode and the center of the above-mentioned sample-solution introducing hole, and has the above-mentioned work electrode of the 1st layer board of the above, and the 2nd layer board of the above was formed joins a field of an opposite hand, A process of joining the 3rd layer board a process of attaching a pipe for sample-solution introduction and a pipe for sample-solution discharge to above-mentioned pipe storage Mizouchi, and a side which has the above-mentioned pipe storage slot of the 2nd layer board of the above is performed.

[0013]
[Embodiment of the Invention]The A-A sectional view of drawing 1 and drawing 3 of the outline sectional view and drawing 2 in which the electrochemical detector which drawing 1 requires for this invention is shown are the B-B sectional views of drawing 1. As shown in a figure, it becomes the 1st layer board 1 that consists of Pyrex (Pyrex) glass from gold, and the work electrode 2 and the leader line 3 whose thickness is about 0.1 micrometer are formed, the work electrode 2 is divided into a sector, and the leader line 3 is connected to the work electrode 2 of each sector. It is provided, the communicating groove 14, i.e., the slot for radial flow cell formation, which connect the round groove 5 about several micrometers deep, the ring shaped groove 6 established in the outside of the round groove 5 and the round groove 5, and the ring shaped groove 6 with the 2nd layer board 4 that consists of Pyrex glass, The round groove 5 and the sample-solution introducing hole 7 which was open for free passage were formed in the 2nd layer board 4, the ring shaped groove 6 and the sample-solution discharge hole 8 which was open for free passage were formed in the 2nd layer board 4, and the sample-solution introducing hole 7 and the sample-solution discharge hole 8 have penetrated the 2nd layer board 4. The field in which the work electrode 2 of the 1st layer board 1 and the leader line 3 were formed, and the field in which the round groove 5 of the 2nd layer board 4, the ring shaped groove 6, and the communicating groove 14 were formed are joined by rare fluoric acid or ultraviolet curing nature adhesives, The radial flow cell 15 is formed between the 1st layer board 1 and the 2nd layer board 4 of the round groove 5, the ring shaped groove 6, and the communicating groove 14. The center of the work electrode 2 and the center of the sample-solution introducing hole 7 are in agreement, and the end of the leader line 3 has projected from the 2nd layer board 4 further. The field joined to the 1st layer board 1 of the 2nd layer board 4 is opened for free passage by the field of an opposite hand with the sample-solution introducing hole 7 and the sample-solution discharge hole 8, and the pipe storage slots 9 and 10 about 0.4 mm deep are formed, In the pipe storage slot 9 and 10, consist of metal and the pipe 11 for sample-solution introduction of 0.4 mm or less and the pipe 12 for sample-solution discharge are attached for an outside, The pipe 11 for sample-solution introduction is used also as a counterelectrode, and it adheres to silver inside the pipe 12 for sample-solution discharge, and the pipe 12 for sample-solution discharge is used also as a reference electrode. The 3rd layer board 13 that becomes the field to which the pipe 11 for sample-solution introduction of the 2nd layer board 4 and the pipe 12 for sample-solution discharge were attached from Pyrex glass is joined, The pipe 11 for sample-solution introduction and the pipe 12 for sample-solution discharge are extended to the exterior of the 2nd layer board 4 and the 3rd layer board 13, The liquid passage which connects the pipe 11 for sample-solution introduction and the pipe 12 for sample-solution discharge by the sample-solution introducing hole 7, the radial flow cell 15, and the sample-solution discharge hole 8 is constituted.
[0014]Below, drawing 4 explains the manufacturing method of the electrochemical detector shown in drawing 1 - drawing 3. First, as shown in drawing 4 (a), the round groove 5, the ring shaped groove 6, and the communicating groove 14 are established in the Pyrex glass wafer by forming the resist mask 21 in the Pyrex glass wafer surface with photolithographic technique, and etching with buffer fluoric acid liquid. Next, as shown in drawing 4 (b), the sample-solution introducing hole 7 and the sample-solution discharge hole 8 are formed in the Pyrex glass wafer by performing perforation by the drill or laser. After establishing the pipe storage slots 9 and 10 in the Pyrex glass wafer by performing cutting by a dicing saw next, the Pyrex glass wafer is divided into the 2nd layer board 4 of a desired size. As shown in drawing 4 (c), after forming the work electrode 2 and the leader line 3 in other Pyrex glass wafers by the lift-off method, the Pyrex glass wafer is divided into the 1st layer board 1 of a desired size. Next, the 1st layer board 1 and the 2nd layer board 4 are joined with rare fluoric acid or ultraviolet curing nature adhesives. In this case, it joins looking at the work electrode 2 from the sample-solution introducing hole 7 under a microscope etc., and the center of the work electrode 2 and the center of the sample-solution introducing hole 7 are coincided. Next, the pipe 11 for sample-solution introduction and the pipe 12 for sample-solution discharge are attached in

the pipe storage slot 9 and 10 by using a photosensitive epoxy resin. Next, the 2nd layer board 4 and the 3rd layer board 13 are joined with rare fluoric acid or ultraviolet curing nature adhesives.
[0015]In the electrochemical detection method machine shown in drawing 1 – drawing 3, since a liquid passage consists of the sample-solution introducing hole 7, the radial flow cell 15, and the sample-solution discharge hole 8 and the shape of a liquid passage is simple, dead volume which stagnation of the sample solution of a liquid passage and dilution produce can be extremely made into a minute amount. The field joined to the 1st layer board 1 of the 2nd layer board 4 establishes the pipe storage slots 9 and 10 in the field of an opposite hand, Since the 3rd layer board 13 is joined to the field which attached the pipe 11 for sample-solution introduction, and the pipe 12 for sample-solution discharge in the pipe storage slot 9 and 10 and to which the pipe 11 for sample-solution introduction of the 2nd layer board 4 and the pipe 12 for sample-solution discharge were attached, a solution does not begin to leak. Therefore, the sample solution can be analyzed correctly.
[0016]In the manufacturing method of the electrochemical detection method machine explained by drawing 4, When joining the 1st layer board 1 and the 2nd layer board 4, it joins looking at the work electrode 2 from the sample-solution introducing hole 7 under a microscope etc., Since the center of the work electrode 2 and the center of the sample-solution introducing hole 7 can be coincided, the quantity of the sample solution which flows on each work electrode 2 does not become unequal and a response becomes the same, the sample solution can be analyzed correctly.
[0017]And a liquid-sending pump (PM-100 by BAS), an injector (8125 by RHEODYNE), and an eight-channel multi-potentiostat (made in the Fuso factory) are connected to the electrochemical detection method machine shown in drawing 1 – drawing 3, 0, 200, 300, 400, 500, 600, and the potential of 700 or 800 mV are impressed to the work electrode 2 divided into eight via the leader line 3 to a reference electrode, respectively, Mix dopamine and metanephrine to pH 1.67 buffer solution, and it prepares so that it may become the concentration of 10microM (mumol/l), respectively, The career solution (pH 1.67 buffer solution) was poured by a part for rate-of-flow 100microl./, 10microl pouring of the mixed sample solution of dopamine and metanephrine was done from the injector, and flow injection analysis was conducted. Then, current increased promptly after pouring of a mixed sample solution, and it returned to the state of the basis. The peak current acquired at this time is shown in Table 1.
[0018]
[Table 1]

印加電圧（ｍＶ）	ピーク電流（ｎＡ）
0	0
200	5
300	88
400	125
500	128
600	183
700	226
800	232

[0019]As a result, it turned out that impressed electromotive force can obtain the concentration of dopamine from the current at 400-500 mV, and that the total concentration of dopamine and metanephrine is obtained from the current at 700-800 mV. With every electrochemical detection method machine which connects a liquid passage simply and which was been [a machine / it] sufficient and produced, the same response was obtained with less than 5% of the error, and the connection was able to analyze the sample solution correctly.
[0020]The outline sectional view and drawing 6 in which other electrochemical detectors which

drawing 5 requires for this invention are shown are a C-C sectional view of drawing 5. As shown in a figure, it becomes the 1st layer board 31 that consists of quartz from carbon, and the work electrode 32 and the leader line 33 whose thickness is about 0.1 micrometer are formed, the work electrode 32 is divided into a sector, and the leader line 33 is connected to the work electrode 32 of each sector. The 5-micrometer-thick insulator layer 34 is formed in the field in which the work electrode 32 of the 1st layer board 31 and the leader line 33 were formed, the circular opening 35 which is an opening for radial flow cell formation is formed in the insulator layer 34, and the work electrode 32 is located in the opening 35. The sample-solution introducing hole 37 and the sample-solution discharge hole 38 were formed in the 2nd layer board 36 that consists of quartz, and the sample-solution introducing hole 37 and the sample-solution discharge hole 38 have penetrated the 2nd layer board 36. The field (insulator layer 34) and the 2nd layer board 36 in which the work electrode 32 of the 1st layer board 31 and the leader line 33 were formed are joined by rare fluoric acid or ultraviolet curing nature adhesives, The radial flow cell 44 is formed between the 1st layer board 31 and the 2nd layer board 36 of the opening 35, and the sample-solution introducing hole 37 and the sample-solution discharge hole 38 are open for free passage with the radial flow cell 44 by it. The center of the work electrode 32 and the center of the sample-solution introducing hole 37 are in agreement, and the end of the leader line 33 has projected from the 2nd layer board 36 further. The field joined to the 1st layer board 31 of the 2nd layer board 36 is opened for free passage by the field of an opposite hand with the sample-solution introducing hole 37 and the sample-solution discharge hole 38, and the pipe storage slots 39 and 40 about 0.4 mm deep are formed, In the pipe storage slot 39 and 40, consist of metal and the pipe 41 for sample-solution introduction of 0.4 mm or less and the pipe 42 for sample-solution discharge are attached for an outside, The pipe 41 for sample-solution introduction is used also as a counterelectrode, and it adheres to silver inside the pipe 42 for sample-solution discharge, and the pipe 42 for sample-solution discharge is used also as a reference electrode. The 3rd layer board 43 that becomes the field to which the pipe 41 for sample-solution introduction of the 2nd layer board 36 and the pipe 42 for sample-solution discharge were attached from quartz is joined, The pipe 41 for sample-solution introduction and the pipe 42 for sample-solution discharge are extended to the exterior of the 2nd layer board 36 and the 3rd layer board 43, The liquid passage which connects the pipe 41 for sample-solution introduction and the pipe 42 for sample-solution discharge by the sample-solution introducing hole 37, the radial flow cell 44, and the sample-solution discharge hole 38 is constituted.

[0021]Below, drawing 7 explains the manufacturing method of the electrochemical detector shown in drawing 5 and drawing 6. First, as shown in drawing 7 (a), a carbon thin film is formed in a quartz wafer surface by the heat CVD (chemical vapor deposition) method, a carbon thin film is selectively etched by the reactive-ion-etching method using photolithographic technique and oxygen, and the work electrode 32 and the leader line 33 are formed. After forming a 0.1-micrometer-thick silicon oxide film in the surface in which the work electrode 32 of a quartz wafer and the leader line 33 were formed, with plasma CVD method next, the insulator layer 34 is formed by the spin one glass method. A quartz wafer is divided into the 1st layer board 31 of a desired size, after forming the resist mask 51 with photolithographic technique and forming the opening 35 by etching the insulator layer 34 and a silicon oxide film selectively with buffer fluoric acid liquid, as shown in drawing 7 (b) next. Next, as shown in drawing 7 (c), by performing perforation by the drill or laser, A quartz wafer is divided into the 2nd layer board 36 of a desired size after establishing the pipe storage slots 39 and 40 in a quartz wafer by forming the sample-solution introducing hole 37 and the sample-solution discharge hole 38 in other quartz wafers, and performing cutting by a dicing saw. Next, the 1st layer board 31 (insulator layer 34) and the 2nd layer board 36 are joined with rare fluoric acid or ultraviolet curing nature adhesives. In this case, it joins looking at the work electrode 32 from the sample-solution introducing hole 37 under a microscope etc., and the center of the work electrode 32 and the center of the sample-solution introducing hole 37 are coincided. Next, the pipe 41 for sample-solution introduction and the pipe 42 for sample-solution discharge are attached in the pipe

storage slot 39 and 40 by using a photosensitive epoxy resin. Next, the 2nd layer board 36 and the 3rd layer board 43 are joined with rare fluoric acid or ultraviolet curing nature adhesives.
[0022]In the electrochemical detection method machine shown in drawing 4 and drawing 5, Since a liquid passage consists of the sample-solution introducing hole 37, the radial flow cell 44, and the sample-solution discharge hole 38 and the shape of a liquid passage is simple, dead volume which stagnation of the sample solution of a liquid passage and dilution produce can be extremely made into a minute amount. The field joined to the 1st layer board 31 of the 2nd layer board 36 establishes the pipe storage slots 39 and 40 in the field of an opposite hand, Since the 3rd layer board 43 is joined to the field which attached the pipe 41 for sample-solution introduction, and the pipe 42 for sample-solution discharge in the pipe storage slot 39 and 40 and to which the pipe 41 for sample-solution introduction of the 2nd layer board 36 and the pipe 42 for sample-solution discharge were attached, a solution does not begin to leak. Therefore, the sample solution can be analyzed correctly.
[0023]In the manufacturing method of the electrochemical detection method machine explained by drawing 7, When joining the 1st layer board 31 and the 2nd layer board 36, it joins looking at the work electrode 32 from the sample-solution introducing hole 37 under a microscope etc., Since the center of the work electrode 32 and the center of the sample-solution introducing hole 37 can be coincided, the quantity of the sample solution which flows on each work electrode 32 does not become unequal and a response becomes the same, the sample solution can be analyzed correctly.
[0024]In the above-mentioned embodiment, although the work electrode 32 and the leader line 33 which consist of the work electrode 2, the leader line 3, and carbon which consist of gold were formed, the work electrode and leader line which consist of platinum, graphite, etc. may be formed. Although the pipe 11 for sample-solution introduction and the pipe 12 for sample-solution discharge which consist of metal were attached in the pipe storage slot 9 and 10 in the above-mentioned embodiment and the pipe 41 for sample-solution introduction and the pipe 42 for sample-solution discharge which consist of metal were attached in the pipe storage slot 39 and 40, The pipe for sample-solution introduction and the pipe for sample-solution discharge which become pipe storage Mizouchi from the capillary tube made from a fused quartz may be attached. In this case, a reference electrode and a counterelectrode are formed in the 1st layer board, and silver is adhered to the end of a reference electrode by silver paste spreading, silver plating, etc. Although homogeneity may be sufficient as an inside diameter and an outer diameter as shape of the pipe for sample-solution introduction, and the pipe for sample-solution discharge, the inside diameter or outer diameter of the pipe for sample-solution introduction and the pipe for sample-solution discharge may be changing to tapered shape in the tube axial direction. In the above-mentioned embodiment, although the pipe storage slots 9 and 10 were established in the 2nd layer board 4 and the pipe storage slots 39 and 40 were established in the 2nd layer board 36, a pipe storage slot may be established in the 3rd layer board, and a pipe storage slot may be established in both the 2nd layer board and the 3rd layer board. Although the work electrode 2 and the leader line 3 were formed in the 1st layer board 1 and the round groove 5, the ring shaped groove 6, and the communicating groove 14 were established in the 2nd layer board 4 in the above-mentioned embodiment, A work electrode and the slot for radial flow cell formation counter one of the 1st layer board and the 2nd layer board, and it should be formed, For example, a work electrode and the slot for radial flow cell formation may be formed in the 2nd layer board, the slot for radial flow cell formation may be further formed in the 1st layer board, and a work electrode may be formed in the 2nd layer board.
[0025]
[Effect of the Invention]In the electrochemical detector concerning this invention, since the shape of a liquid passage is simple, dead volume which stagnation of the sample solution of a liquid passage and dilution produce can be extremely made into a minute amount and a solution does not begin to leak, the sample solution can be analyzed correctly.

[0026]In the manufacturing method of the electrochemical detector concerning this invention, Since the center of a work electrode and the center of a sample-solution introducing hole can be coincided by joining looking at a work electrode from a sample-solution introducing hole under a microscope etc. when joining the 1st layer board and the 2nd layer board, the sample solution can be analyzed correctly.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]It is an outline sectional view showing the electrochemical detector concerning this invention.
[Drawing 2]It is an A-A sectional view of drawing 1.
[Drawing 3]It is a B-B sectional view of drawing 1.
[Drawing 4]It is an explanatory view of the manufacturing method of the electrochemical detector shown in drawing 1 - drawing 3.
[Drawing 5]It is an outline sectional view showing other electrochemical detectors concerning this invention.
[Drawing 6]It is a C-C sectional view of drawing 5.
[Drawing 7]It is an explanatory view of the manufacturing method of the electrochemical detector shown in drawing 5 and drawing 6.
[Description of Notations]
1 -- The 1st layer board
2 -- Work electrode
4 -- The 2nd layer board
5 -- Round groove
6 -- Ring shaped groove
7 -- Sample-solution introducing hole
8 -- Sample-solution discharge hole
9 -- Pipe storage slot
10 -- Pipe storage slot
11 -- Pipe for sample-solution introduction
12 -- Pipe for sample-solution discharge
13 -- The 3rd layer board
14 -- Communicating groove
15 -- Radial flow cell
31 -- The 1st layer board
32 -- Work electrode

34 -- Insulator layer
35 -- Opening
36 -- The 2nd layer board
37 -- Sample-solution introducing hole
38 -- Sample-solution discharge hole
39 -- Pipe storage slot
40 -- Pipe storage slot
41 -- Pipe for sample-solution introduction
42 -- Pipe for sample-solution discharge
43 -- The 3rd layer board
44 -- Radial flow cell

[Translation done.]

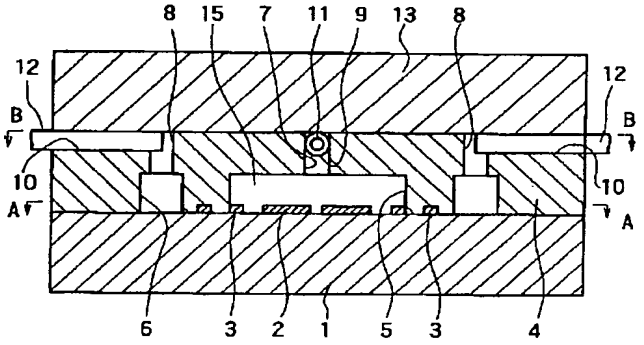
* NOTICES *

JPO and INPIT are not responsible for any
damages caused by the use of this translation.

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

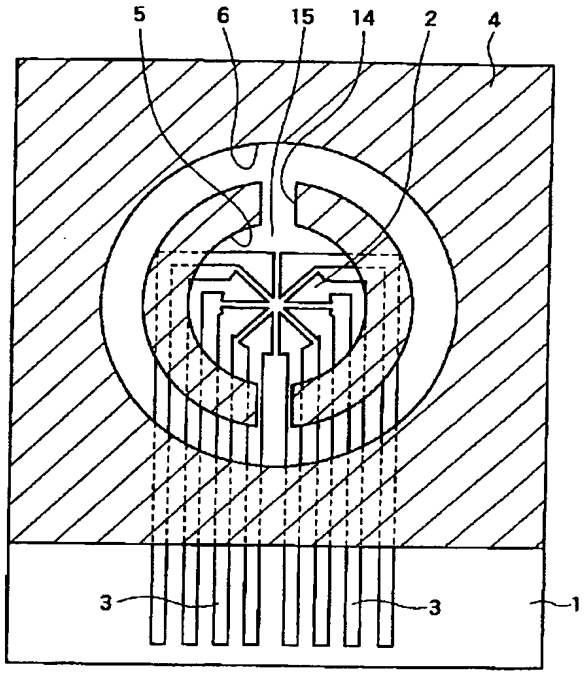
DRAWINGS

[Drawing 1]
図1



1…第1層基板
2…作用電極
4…第2層基板
5…円形溝
6…リング状溝
7…試料溶液導入孔
8…試料溶液排出孔
9…パイプ収納溝
10…パイプ収納溝
11…試料溶液導入用パイプ
12…試料溶液排出用パイプ
13…第3層基板
15…ラディアルフローセル

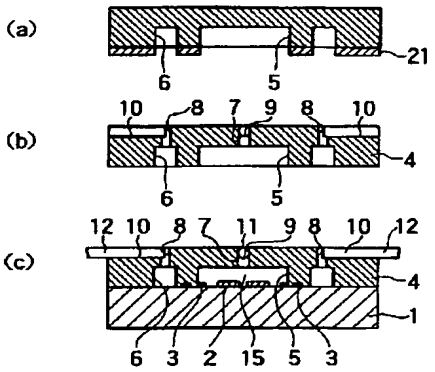
[Drawing 2]
図2



1…第1層基板　　6…リング状溝
2…作用電極　　14…連通溝
4…第2層基板　　15…ラディアルフローセン
5…円形溝

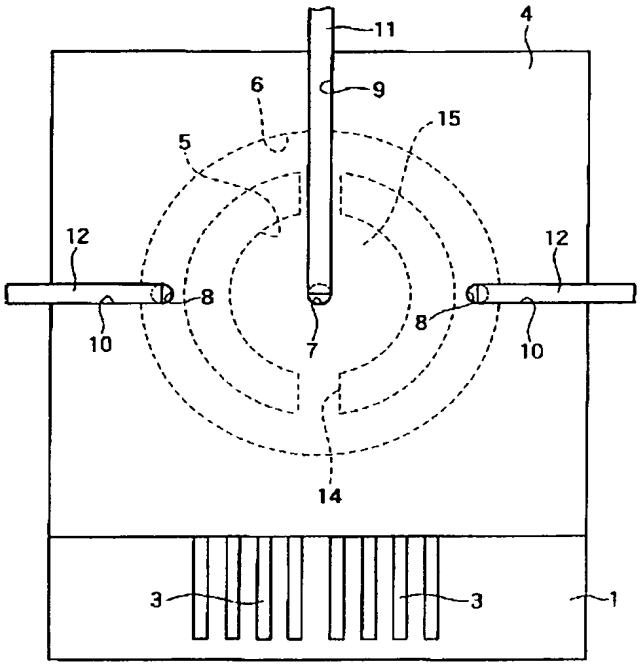
[Drawing 4]

図4



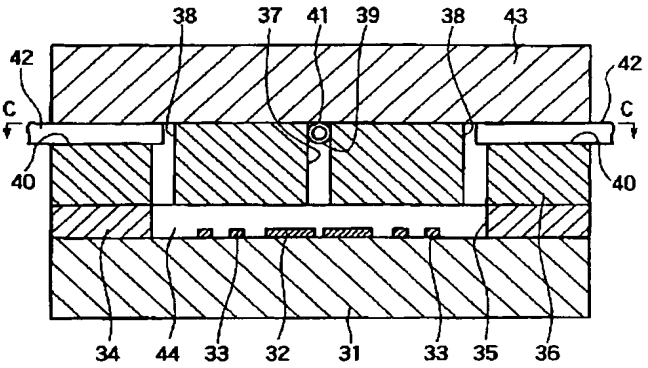
1…第1層基板
4…第2層基板
5…円形溝
6…リング状溝
7…試料溶液導入孔
8…試料溶液排出孔
9…パイプ収納溝
10…パイプ収納溝
11…試料溶液導入用パイプ
12…試料溶液排出用パイプ
15…ラディアルフローセル

[Drawing 3]
図3



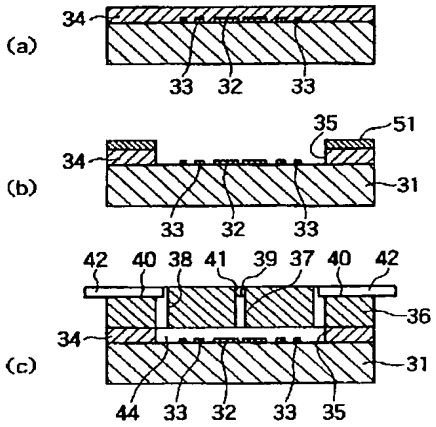
1…第1層基板
4…第2層基板
5…円形溝
6…リング状溝
7…試料溶液導入孔
8…試料溶液排出孔
9…パイプ収納溝
10…パイプ収納溝
11…試料溶液導入用パイプ
12…試料溶液排出用パイプ
14…連通溝
15…ラディアルフローセル

[Drawing 5]
図5



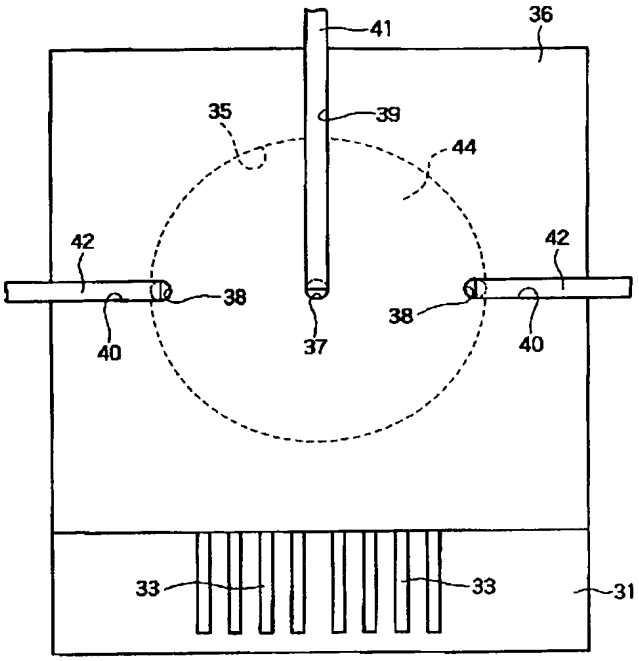
３１･･･第1層基板
３２･･･作用電極
３４･･･絶縁膜
３５･･･開口部
３６･･･第2層基板
３７･･･試料溶液導入孔
３８･･･試料溶液排出孔
３９･･･パイプ収納溝
４０･･･パイプ収納溝
４１･･･試料溶液導入用パイプ
４２･･･試料溶液排出用パイプ
４３･･･第3層基板
４４･･･ラディアルフローセル

[Drawing 7]
図7



３１･･･第1層基板
３２･･･作用電極
３４･･･絶縁膜
３５･･･開口部
３６･･･第2層基板
３７･･･試料溶液導入孔
３８･･･試料溶液排出孔
３９･･･パイプ収納溝
４０･･･パイプ収納溝
４１･･･試料溶液導入用パイプ
４２･･･試料溶液排出用パイプ
４４･･･ラディアルフローセル

[Drawing 6]
図6



31…第1層基板
35…開口部
36…第2層基板
37…試料溶液導入孔
38…試料溶液排出孔
39…パイプ収納溝
40…パイプ収納溝
41…試料溶液導入用パイプ
42…試料溶液排出用パイプ
44…ラディアルフローセル

[Translation done.]